VOL. 04 NO. 06 September 1998

USACHPPM

MSMR

Medical Surveillance Monthly Report

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Army Medical Surveillance Activity (AMSA)

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
SEP 1998		**00-00-1998 to 00-00-1998**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Medical Surveillance Monthly Report (MSMR). Volume 4, Number 6, September 1998	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Center for Health Promotion and Preventive Medicine,Armed Forces Health Surveillance Center (AFHSC),2900 Linden Lane, Suite 200,Silver Spring,MD,20910**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**20**	

Deployment surveillance

Morbidity Surveillance During a Joint Multinational Field Training Exercise (OPERATION COBRA GOLD 98), Thailand

Operation Cobra Gold is a combined/joint air, land, maritime, amphibious and special operations exercise that is conducted biennially in Thailand. In 1998, the Cobra Gold exercise was conducted by a task force composed of Thai and US (Air Force, Army, Marine, and Navy) forces. The major field training portion of Cobra Gold 98 (CG98) took place in May. A Theater Medical Surveillance Team (TMST) from the Navy and a Theater Diarrhea and Febrile Illness Surveillance Team (TDFIST) from the Army and Navy deployed to Thailand during the busiest period of field operations to assist in the conduct of theater-wide medical surveillance. This report summarizes the disease and non-battle injury (DNBI) experiences of US participants in CG98.

DNBI surveillance was conducted at six field clinics dispersed throughout the CG98 exercise areas: Kanchanaburi, Utapao, Samaesan, Korat, Lopburi, and Takhli. Each clinic provided weekly reports of outpatient visits in 17 medical categories to a central database. Because of the anticipated high risk of food and waterborne illnesses, intensive surveillance of diarrhea was conducted at three of the field clinics (Kannchanaburi, Utapao, and Samaesan). At these sites, all patients with diarrheal illnesses (defined as > 3 loose bowel movements in a 24-hour period) and randomly selected, unaffected controls received detailed clinical and laboratory evaluations and follow-ups.

DNBI surveillance: Each week during the exercise, approximately 7% of the US forces presented to a clinic with an illness or injury. This rate was comparable to DNBI rates during previous Cobra Gold exercises. Among specific categories of illnesses/injuries, the highest rates were for dermatologic, gastrointestinal, and upper respiratory illnesses (figure). Dermatologic conditions were commonly related to sunburn and heat-associated rashes, especially among Marines. Diarrhea rates were highest in the 2nd and 3rd weeks of the month long exercise. Diarrhea risk was associated with the consumption of indigenous foods. Upper respiratory illnesses (URI) generally presented as routine viral-like syndromes. URI rates peaked in the 2nd and 3rd weeks of the exercise, and in some settings, relatively high URI rates were associated with more crowded living conditions. Work and recreation/sports-related injury rates were higher in the second than the first half of the exercise. Finally, heat injuries were highest in the first week of the exercise with members of advance parties most affected - perhaps due to high work tempos and lack of acclimatization.

Diarrhea surveillance: At the three sentinel clinics that conducted in-depth diarrhea surveillance, there were 156 cases and 80 noncases that received detailed clinical and laboratory evaluations. Nearly two-thirds (62%) of the cases and

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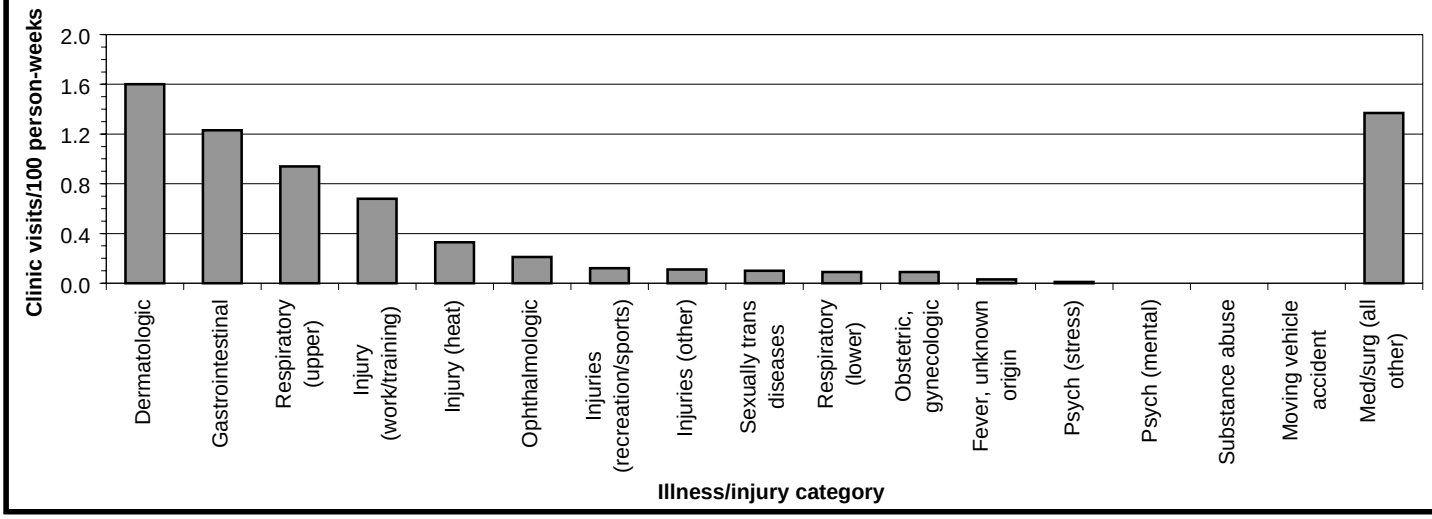
To be added to the mailing list, contact the Army Medical Surveillance Activity @ DSN 662-0471, Comm: (202) 782-0471.

nearly one-fourth (24%) of the noncases had bacterial pathogens recovered from stool specimens. The most frequently isolated bacterial pathogens (from both cases and noncases) were *Salmonella enteritidis*, entero-adherent *E. coli* (EAEC), entero-toxigenic *E. coli* (ETEC), and *Campylobacter* species (table).

Editorial comment: DNBI surveillance of deployed forces is an essential aspect of field operational preventive medicine support. During the 4-week long CG98 exercise, the US Navy's efforts to detect and rapidly characterize significant and emerging DNBI threats enabled the theater surgeon to develop and implement specific and timely countermeasures. In addition, the diarrhea surveillance team defined the nature and extent of diarrheal illnesses among exercise participants and provided prompt diagnostic and treatment support to deployed medical care providers. Joint medical surveillance teams can play important roles in support of joint and multinational operations and exercises.

Information and comments provided by MAJ William Hewitson, MC, and COL Jose Sanchez, MC, USA, USACHPPM; MAJ Daniel Isenbarger, MC, and LTC Lorrin Pang, MC, USA, Armed Forces Research Institute of the Medical Sciences , Thailand; LT John Sanders, MC, CAPT Steve Walz, MC, and CDR David Tribble, MC, USN, Navy Medical Research Institute, Bethesda, MD; and HMCS Cheri Inverso, LT Prendergast, MSC, and LT Monteville, MSC, USN, Navy Environmental and Preventive Medicine Unit No. 6, Pearl Harbor, HI.

Disease and non-battle injury (DNBI) rates, by illness/injury category, among US military participants, Cobra Gold 98, Thailand



Bacterial isolates from US military personnel, Cobra Gold 98, Thailand

Pathogen	Diarrhea Cases (n=156)		Noncases (n=80)	
	No. of cultures + for pathogen	Isolation rate (% of cultures + for pathogen)	No. of cultures + for pathogen	Isolation rate (% of cultures + for pathogen)
Salmonella enteritidis	32	21%	9	11%
Entero-adherent *E. coli (EAEC)*	27	17%	6	8%
Entero-toxigenic *E. coli (ETEC)*	24	15%	2	3%
Campylobacter spp.	24	15%	2	3%
Plesiomonas	9	6%	0	0%
Vibrio parahemolyticus	6	4%	0	0%
Non-agglutinating vibrios	3	2%	1	1%
Shigella spp.	1	<1%	0	0%
Entero-invasive *E. coli (EIEC)*	1	<1%	0	0%

TABLE I. Selected sentinel reportable diseases, US Army medical treatment facilities*
August, 1998

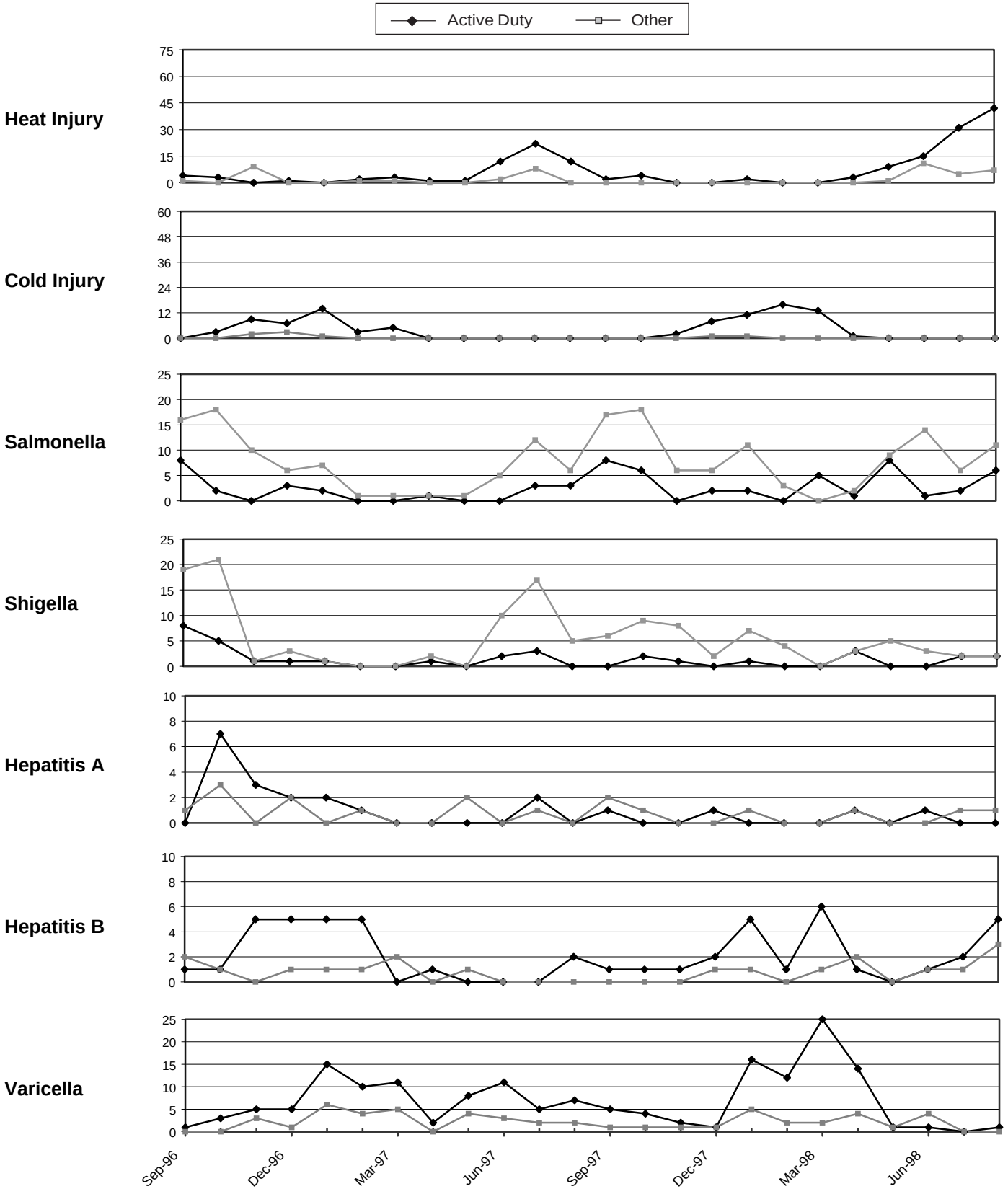
Reporting MTF/Post**	Total number of reports submitted August 1998	Environmental Injuries		Viral Hepatitis		Salmonellosis		Shigella		Varicella	
		Active Duty				Active Duty	Other	Active Duty	Other	Active Duty	Other Adult
		Heat	Cold	A	B						
		Cum. 1998	Cum. 1998	Cum. 1998	Cum. 1998	Cum. 1998	Cum. 1998	Cum. 1998	Cum. 1998	Cum. 1998	Cum. 1998
NORTH ATLANTIC RMC											
Walter Reed AMC	8	0	0	2	0	2	3	0	0	4	0
Aberdeen Prov. Ground, MD	7	1	0	0	1	0	0	0	0	0	0
FT Belvoir, VA	22	0	0	0	0	0	9	0	1	1	0
FT Bragg, NC	12	18	1	0	0	13	19	2	16	0	0
FT Drum, NY	31	0	14	0	2	0	0	0	0	2	4
FT Eustis, VA	17	10	0	0	0	0	2	1	3	5	2
FT Knox, KY	34	5	0	0	0	0	0	0	0	18	0
FT Lee, VA	0	0	0	0	2	0	0	0	0	0	0
FT Meade, MD	9	0	0	0	0	0	1	0	0	4	0
West Point, NY	10	0	0	1	1	0	1	0	0	0	1
GREAT PLAINS RMC											
Brooke AMC	22	1	0	4	2	1	5	0	1	2	0
Beaumont AMC	30	0	0	0	0	0	3	0	2	7	1
FT Carson, CO	91	5	2	0	0	1	2	0	0	3	0
FT Hood, TX	0	3	0	0	8	0	0	1	2	2	1
FT Huachuca, AZ	9	0	0	0	0	0	1	0	0	0	0
FT Leavenworth, KS	44	0	0	0	0	0	1	0	0	0	0
FT Leonard Wood, MO	17	3	1	0	0	1	0	0	0	14	7
FT Polk, LA	33	4	0	0	0	0	0	0	0	0	0
FT Riley, KS	8	0	1	0	0	1	0	1	0	3	0
FT Sill, OK	50	10	0	0	8	0	0	0	0	0	0
SOUTHEAST RMC											
Eisenhower AMC	35	3	0	0	1	0	0	0	0	0	0
FT Benning, GA	16	12	1	0	1	1	1	0	3	2	0
FT Campbell, KY	70	1	1	0	0	0	3	2	5	1	4
FT Jackson, SC	0	3	1	2	0	0	1	0	1	5	0
FT McClellan, AL	1	6	0	0	0	0	0	0	0	0	0
FT Rucker, AL	5	0	0	0	0	0	0	0	0	0	0
FT Stewart, GA	41	23	1	0	0	0	0	0	1	3	0
WESTERN RMC											
Madigan AMC	0	0	0	0	0	0	3	0	0	3	0
FT Irwin, CA	0	0	0	0	2	0	0	0	0	0	0
FT Wainwright, AK	0	0	9	0	0	0	0	0	0	0	0
OTHER LOCATIONS											
Tripler	71	1	0	1	1	0	4	0	0	0	0
Europe	0	1	22	2	20	24	21	1	0	7	5
Korea	88	6	0	3	8	0	0	0	0	1	0
Total	**781**	**116**	**54**	**15**	**57**	**44**	**80**	**8**	**35**	**87**	**25**

* Based on date of onset.

** Reports are included from main and satellite clinics. Not all sites reporting.

Date of Report: 7-Sep-98

FIGURE I. Selected sentinel reportable diseases, US Army medical treatment facilities*
Cases per month, Sep 96 - Aug 98



* Reports are included from main and satellite clinics. Not all sites reporting.

Date of report: 7-Sep-98

TABLE II. Reportable sexually transmitted diseases, US Army medical treatment facilities*
August, 1998

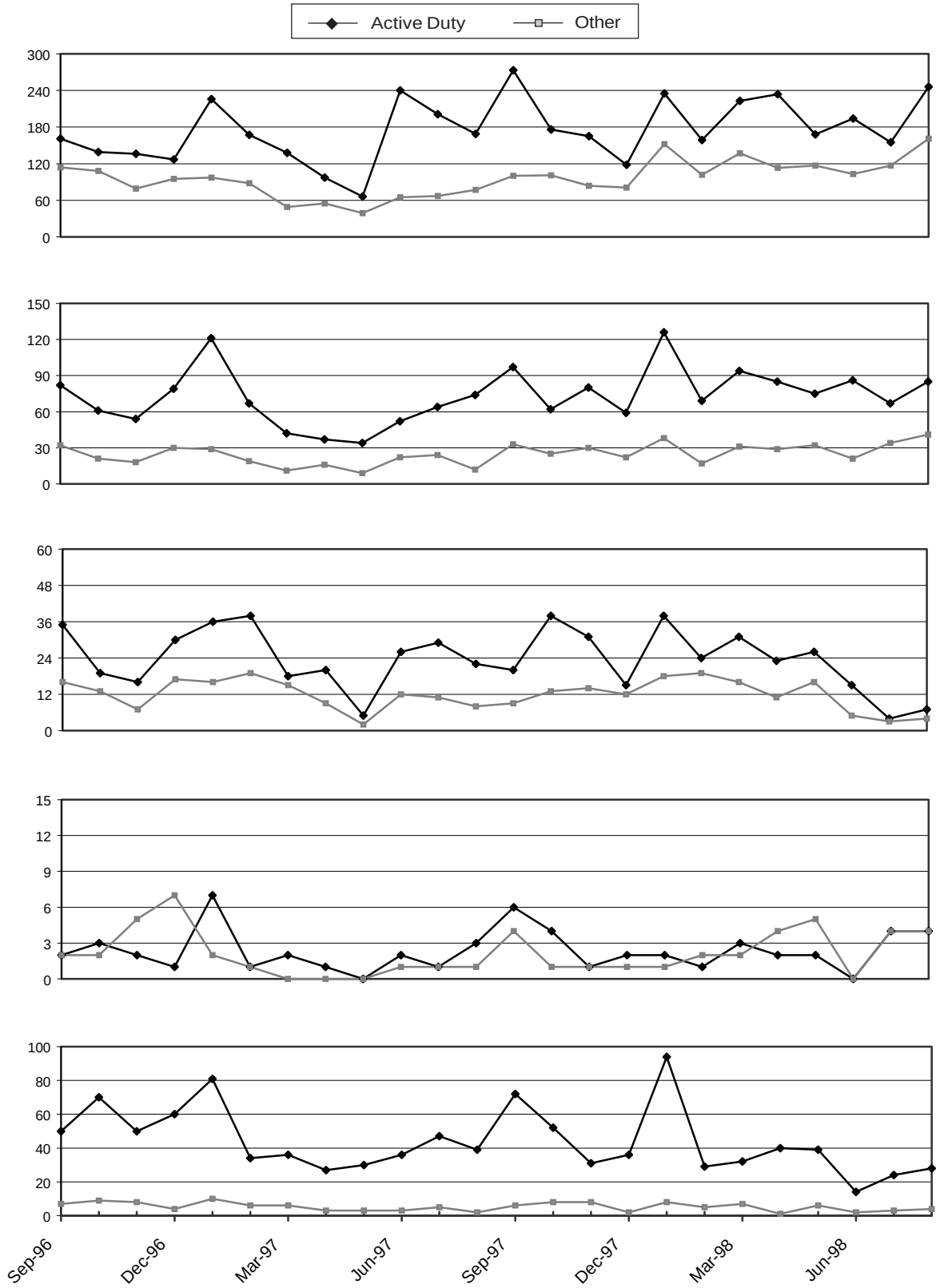
Reporting MTF/Post**	Chlamydia		Urethritis non-spec.		Gonorrhea		Herpes Simplex		Syphilis Prim/Sec		Syphilis Latent		Other STDs**	
	Cur. Month	Cum. 1998	Cur. Month	Cum. 1998	Cur. Month	Cum. 1998	Cur. Month	Cum. 1998	Cur. Month	Cum. 1998	Cur. Month	Cum. 1998	Cur. Month	Cum. 1998
NORTH ATLANTIC RMC														
Walter Reed AMC	5	43	1	8	6	21	0	10	0	0	0	2	0	2
Aberdeen Prov. Ground, MD	6	22	1	2	0	2	0	1	0	0	0	0	0	0
FT Belvoir, VA	10	110	0	0	5	33	1	32	4	4	0	0	2	13
FT Bragg, NC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FT Drum, NY	11	77	1	4	9	31	0	9	0	1	0	1	0	0
FT Eustis, VA	14	81	0	0	4	32	0	0	0	0	0	1	0	0
FT Knox, KY	15	127	0	0	4	45	0	28	0	0	0	1	0	0
FT Lee, VA	0	20	0	0	0	15	0	0	2	2	0	0	0	0
FT Meade, MD	3	44	3	34	1	6	0	25	1	3	0	0	0	0
West Point, NY	6	16	0	0	2	6	0	4	0	0	0	0	0	0
GREAT PLAINS RMC														
Brooke AMC	17	122	0	0	5	36	0	1	0	1	0	0	0	0
Beaumont AMC	18	182	0	0	1	55	0	18	0	1	0	2	0	0
FT Carson, CO	45	339	8	96	5	66	0	18	0	1	0	0	0	0
FT Hood, TX	9	542	3	131	3	263	0	49	0	2	0	0	0	3
FT Huachuca, AZ	2	15	0	0	0	5	0	0	0	0	0	0	0	0
FT Leavenworth, KS	1	18	0	0	0	1	0	0	0	0	0	0	0	0
FT Leonard Wood, MO	8	70	1	23	7	29	0	0	0	0	0	0	0	1
FT Polk, LA	15	65	0	0	4	17	0	1	0	1	0	0	0	0
FT Riley, KS	28	155	0	0	7	50	0	1	1	1	0	0	0	0
FT Sill, OK	15	106	2	27	6	69	0	7	0	0	0	0	0	3
SOUTHEAST RMC														
Eisenhower AMC	21	168	0	0	4	19	0	22	0	0	0	0	0	0
FT Benning, GA	0	114	0	3	0	42	0	15	0	0	0	0	0	0
FT Campbell, KY	32	279	0	0	10	116	0	9	0	1	0	1	0	0
FT Jackson, SC	0	105	0	0	0	40	0	3	0	0	0	0	0	5
FT McClellan, AL	3	5	0	0	0	2	0	0	0	0	0	0	0	0
FT Rucker, AL	2	26	0	0	0	5	0	3	0	0	0	0	0	0
FT Stewart, GA	6	95	12	122	15	82	4	46	0	0	0	2	0	0
WESTERN RMC														
Madigan AMC	0	153	0	63	0	20	0	13	0	0	0	0	0	0
FT Irwin, CA	1	24	0	0	0	3	0	0	0	0	0	0	0	0
FT Wainwright, AK	0	32	0	0	0	2	0	2	0	0	0	0	0	0
OTHER LOCATIONS														
Tripler	41	203	0	0	13	56	4	57	0	0	0	0	0	0
Europe	69	537	0	0	15	96	0	22	0	7	0	1	0	4
Korea	4	43	0	0	0	15	2	4	0	0	0	0	0	0
Total	**407**	**3938**	**32**	**513**	**126**	**1280**	**11**	**400**	**8**	**25**	**0**	**11**	**2**	**31**

* Reports are included from main and satellite clinics. Not all sites reporting. Date of Report: 7-Sep-98

** Other STDs: (a) Chancroid (b) Granuloma Inguinale (c) Lymphogranuloma Venereum (d) Syphilis unspec. (e) Syph, tertiary (f) Syph, congenital

FIGURE II. Reportable sexually transmitted diseases, US Army medical treatment facilities*

Cases per month, Sep 96 -Aug 98



* Reports are included from main and satellite clinics. Not all sites reporting.

Date of report: 7-Sep-98

Epidemiologic consultation (EPICON)

Rapidly-growing Mycobacterial Infections among Bone Marrow Transplant Recipients, Brooke Army Medical Center, San Antonio, Texas

Rapidly-growing mycobacteria (RGM) are a group of nontuberculous mycobacteria that are ubiquitous in the environment, especially in soil and water. It has been known for years that RGMs inhabit many natural water sources (e.g., rivers, streams, lakes) worldwide; but until recently, RGMs were not considered significant threats to human health. In the past few decades, however, RGMs have been recognized as potential causes of serious localized (e.g., skin, wound, prosthetic devices) and systemic (e.g., bacteremia) infections, especially in severely immunocompromised hosts.

Bone marrow transplantation (BMT) through intravenous infusion of bone marrow stem cells was first attempted in humans in 1939. Since then, bone marrow stem cell transplantation has become an established treatment for intractable lymphomas, leukemias, solid tumors (especially breast cancer), aplastic anemia, thalassemia, immunodeficiency syndromes, and genetic-metabolic disorders.[1] Unfortunately, bone marrow transplantation is also associated with profound suppression of cell-mediated immunity due to pretransplant chemo- and radiotherapies, graft-versus-host disease, transplant-related procedures, effects of underlying illnesses, and/or complications of the above. Thus, BMT patients are highly susceptible to "opportunistic" infections including RGM.[1]

Background: Between 1 April 1997 and 31 May 1998, 14 patients at Brooke Army Medical Center (BAMC), Fort Sam Houston, Texas, were diagnosed with RGM infections. Blood cultures revealed that seven (50%) patients had *Mycobacterium chelonae*, five (36%) *Mycobacterium fortuitum*, and two (14%) mixed RGM infections. All but one of the RGM cases were hospitalized on BAMC's bone marrow transplant unit (BMTU) prior to or at the time of RGM detection. Upon request, a team from the US Army Center for Health Promotion and Preventive Medicine (USACHPPM) assisted the BAMC staff to identify and characterize factors associated with RGM infection risk and to develop intervention plans. This report summarizes preliminary findings of the investigation.

Scope of the investigation: The investigation focused on the inpatient experience of Brooke Army Medical Center between 1 May 1997 and 8 June 1998. The investigation's objectives were to define the nature, extent, rates, and trends of RGM infections among BMT recipients, specifically and in relation to other severely immunosuppressed non-BMT patients; to define high-risk patient populations and time period(s) of increased incidence; to define risk correlates for acquiring RGM infections, including medical procedures, underlying illnesses, and water exposures; to identify and culture potential environmental (water) sources of infection; to compare characteristic genetic sequences ("DNA fingerprints") of clinical and environmental RGM isolates; and to provide recommendations for the prevention and control of future RGM infections.

Case detection: Hospitalization and clinical microbiology records were searched to identify all patients with discharge diagnoses or culture results indicative of rapidly-growing mycobacterial infections. Of 14 cases identified, all but one had received autologous peripheral blood stem cell infusions on the BAMC bone marrow transplant unit (BMTU). All cases detected by systematic retrospective record reviews were already known to the BAMC infection control staff.

Incidence rates, trends: Records of the BAMC bone marrow transplant unit revealed that, from October 1993 though October 1996, there were no RGM infections associated with 158 bone marrow transplants (incidence rate [IR]: 0.0 in-

fections per 100 BMTs, 95% CI: 0.0–2.3). During fiscal year 1997, there were 3 infections associated with 90 transplants (IR: 3.3 per 100 BMTs, 95% CI: 0.7-9.7). From October 1997 through May 1998, there were 10 infections associated with 75 transplants (IR: 13.3 per 100 BMTs, 95% CI: 6.4-24.5). In comparison, the BMT program at the University of Minnesota Hospital reported seven RGM infections among 2,241 BMT recipients over a 20-year period (IR: 0.3 per 100 BMTs, 95% CI: 0.1-0.6).[2] In two other non-military case series reviews, no RGM infections were diagnosed among 682 (IR: 0.0 per 100 BMTs, 95% CI: 0.0-0.5) and 90 (IR: 0.0 per 100 BMTs, 95% CI: 0.0-4.1) BMT patients.[3,4] Thus, BAMC's recent BMT-related RGM experience markedly varied from its own prior and from others' reported experiences.

Infection control procedures (general): To assess hospital-acquired infection experience on the bone marrow transplant unit, RGM and staphylococcal (*S. aureus, S. epidermidis*) infection rates were compared between BMTU and hematology-oncology patients. Rates of RGM and staphylococcal infections were calculated by dividing the number of laboratory confirmed infections among patients on the BMT and hematology-oncology wards by the respective total inpatient-days. During the period, RGM rates were nearly 30 times higher among BMT patients compared to hematology-oncology patients (BMT rate: 3.26 RGM infections per 1,000 patient-days; hematology/oncology rate: 0.12 RGM infections per 1,000 patient-days); however, staphylococcal rates were higher among hematology-oncology than BMT patients (BMT rate: 1.26 staphylococcal infections per 1,000 patient-days; hematology/oncology rate: 2.32 staphylococcal infections per 1,000 patient-days) (figure 1). Thus, the increased rate of RGM infections among BMT patients did not seem to reflect a predisposing breakdown of infection control diligence on the BMTU.

Figure 1. Infection rates among hospitalized patients, bone marrow transplant (BMT) and hematology-oncology units, Brooke Army Medical Center, January 97 - May 98

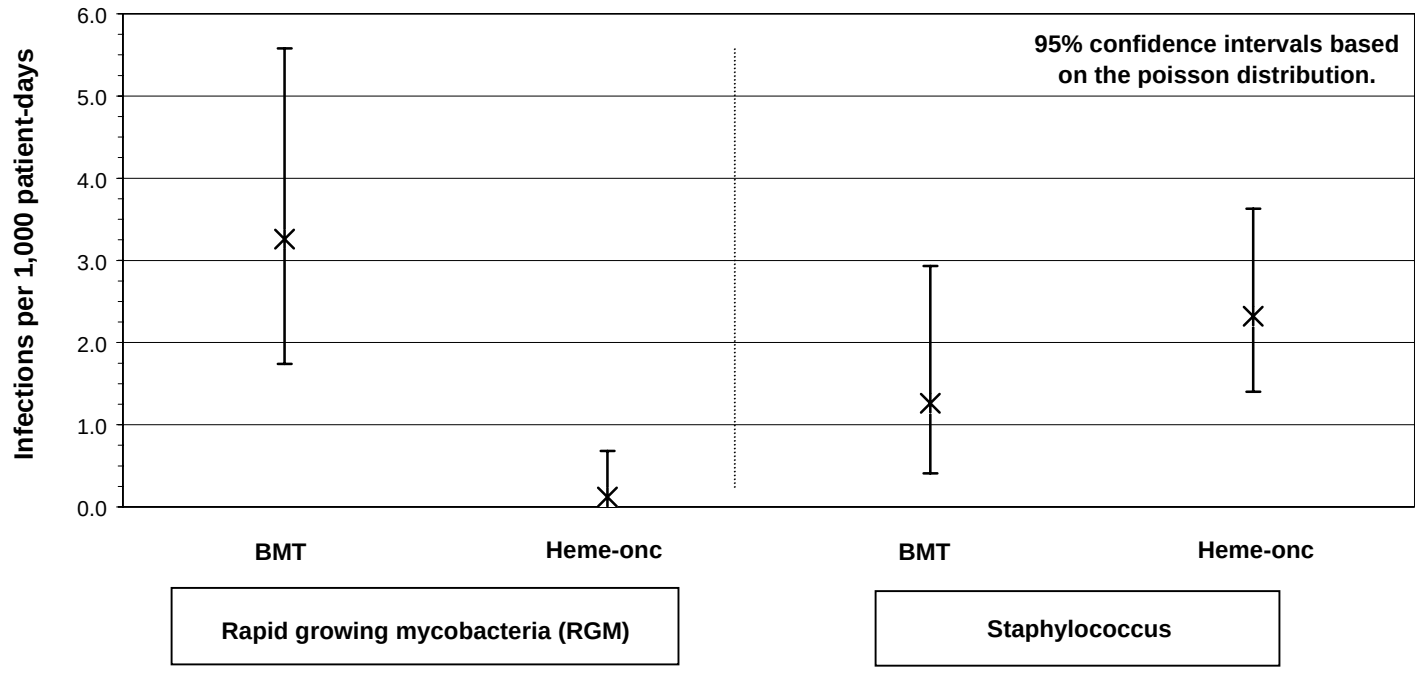


Table 1. Demographic, medical and procedure-related characteristics of case and control patients, BAMC RGM outbreak investigation, June 1998

Variable	BMTU		Heme-onc	Odds ratio	Odds ratio
	cases (n=14)	controls ("internal") (n=23)	controls ("external") (n=23)	BMTU cases vs BMTU controls	BMTU cases vs Heme-onc controls
Age (mean)	49.0	44.1	43.7	na	na
Female (%)	79	78	26	1.0	10.4*
Caucasian (%)	86	64	62	3.4	3.7
Married (%)	92	100	77	0.3	3.2
History of breast cancer (%)	71	78	13	0.7	16.7*
History of smoking (%)	0	15	24	---	---
History of chronic disease (%)	50	26	30	1.5	1.4
In hospital, # of days (mean)	17.1	13.5	19.6	na	na
Severe neutropenia, # of days (mean)	7.2	6.1	18.7*	na	na
Maximum temperature (^{o}F) (mean)	102.2*	100.7	102.3*	na	na
Mucositis during hospitalization (%)	71*	74*	30	0.9	5.7*
Blood culture (+) during hospitalization (%)	85*	31	60	12.1*	3.7
Central venous catheter, any type (%)	93	100	74	0.0	4.6
Central venous catheter, triple lumen (%)	86*	78	57	1.7	4.6*
Central venous catheter, brand "A" (%)	71*	74*	9	0.9	26.3*
Central venous catheter, inflammation (%)	69*	44*	13	2.9	15.0*
Stem cells infused, # bags (mean)	6.4	5.8	na	na	na
Stem cells infused, # frozen bags (mean)	5.0	5.6	na	na	na

** indicates differences are nominally statistically significant.*

Case-noncase comparisons, general: To identify and quantify specific correlates of infection risk, RGM cases were compared to similarly immunocompromised noncases in relation to demographic, medical, and procedure-related characteristics. For this investigation, separate referent groups were selected from among both BMTU ("internal controls") and hematology-oncology ward ("external controls") patients. Two noncases (from each referent group) were selected at random from among patients admitted in the same month as cases. Records of relevant hospitalizations of each RGM case and referent noncase were reviewed, and data were recorded on forms developed specifically for the investigation.

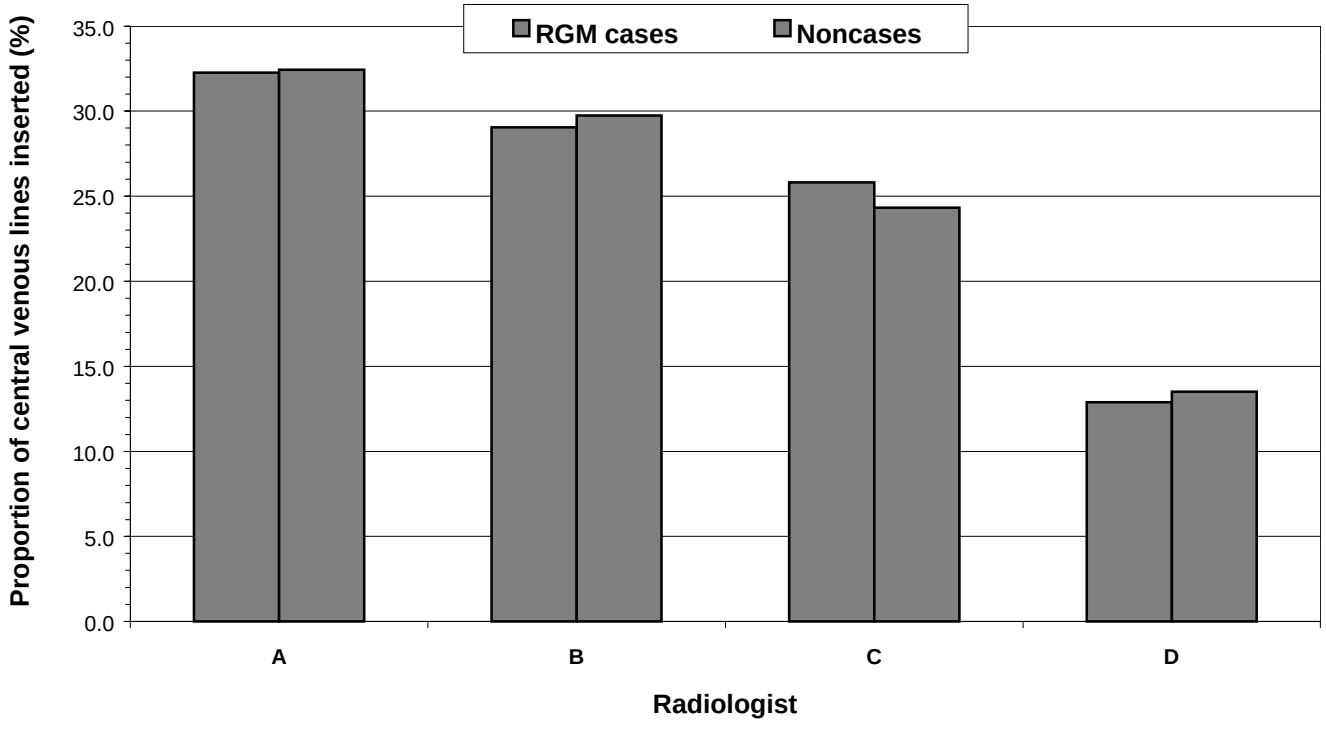
Cases versus BMTU noncases ("internal controls"): Among bone marrow transplant patients, RGM cases were slightly older, more often Caucasian, more likely to have intercurrent chronic illnesses (e.g., diabetes), and less likely to smoke than noncases. The hospitalizations of cases were longer than those of noncases, and during their

hospitalizations, cases had more days of severe neutropenia (< 600 WBCs/mm^3) and higher maximum temperatures. Finally, more cases (69%) than noncases (44%) developed signs of central venous line inflammation (at the insertion site and/or the subcutaneous tunnel), and 85% of cases, compared to only one third (31%) of noncases, had at least one positive blood culture for any bloodborne pathogen (including staphylococcus and RGM species) during hospitalization. The blood culture difference was the only statistically significant discriminator between the cases and the internal controls (table 1).

Cases versus hematology-oncology ("external controls") noncases: Cases were significantly more likely than hematology-oncology noncases to have a diagnosis of breast cancer (and also to be female), to have mucositis (inflammation and erosion of mucosal surfaces), and to have signs of central venous (CV) catheter inflammation.

Risk associated with CV catheters: During the study period, nearly all BMT and approximately three fourths of hematology-oncology patients had CV catheters placed to secure venous access. Four different radiologists surgically inserted CV catheters (n=68) in BMT patients; however, no radiologist inserted relatively more CV catheters of RGM cases than noncases (figure 2). BMT patients (both cases and noncases) were more likely than hematology-oncology patients to have CV catheters with three internal channels ("triple lumen"), and most triple-lumen catheters of BMT patients were supplied by a single manufacturer ("company A"). However, similar proportions of BMT cases (71%) and noncases (74%) had "company A" brand triple-lumen CV catheters. Thus, there were no associations between RGM infection risk and either the type or manufacturer of or the physician who inserted the CV catheters of BMT patients.

Figure 2. Distribution of central venous catheter placements among RGM cases and non-cases, by radiologist who performed insertion procedure, Brooke Army Medical Center, January 1997 - May 1998



Multivariate analysis: In a multivariate model that included data from cases and both internal and external controls and adjusted for effects of age, gender, and race, only CV catheter inflammation and a positive blood culture during hospitalization were statistically significantly correlated with RGM infection risk (table 2).

Environmental assessment: BAMC is a large, modern medical complex located approximately five miles from the main post area of Fort Sam Houston. BAMC receives its potable water from the Fort Sam Houston water treatment plant. Before centrally treated water is distributed within the hospital, however, it is retreated to adjust its "softness" and its chlorine content.

Results of microbiologic sampling of BAMC's potable water were reviewed to identify times and potential sources of bacterial contamination, particularly with mycobacterial species. Of 32 water samples collected from the BMTU (mainly from taps, showers, drinking fountains, and ice machines) in February 1998, none were positive for mycobacteria. However, 3 of 3 samples collected in March, 24 of 30 in April, and 27 of 27 in May were positive – and concentrations of mycobacteria in positive samples seemed to increase between March and May. On 13 May, hyperchlorination of the hospital plumbing system was attempted, and in early June (prior to and during the epidemiologic investigation), samples were taken from points along the main post and BAMC water distribution systems to pinpoint location(s) and source(s) of potential contamination. Samples from throughout the hospital, at the point where Fort Sam Houston water enters the separate BAMC system, and from BAMC's water softener (including the resin, effluent, and backwash) were positive for RGM. In contrast, untreated water from the aquifer that serves Fort Sam Houston (and much of central Texas) and finished water from the main post plant were negative for mycobacteria. Thus, it appeared that water from the main post treatment plant was becoming contaminated in the pipeline between the main post and the hospital (or possibly at its point of entry into the hospital).

Continued on page 14

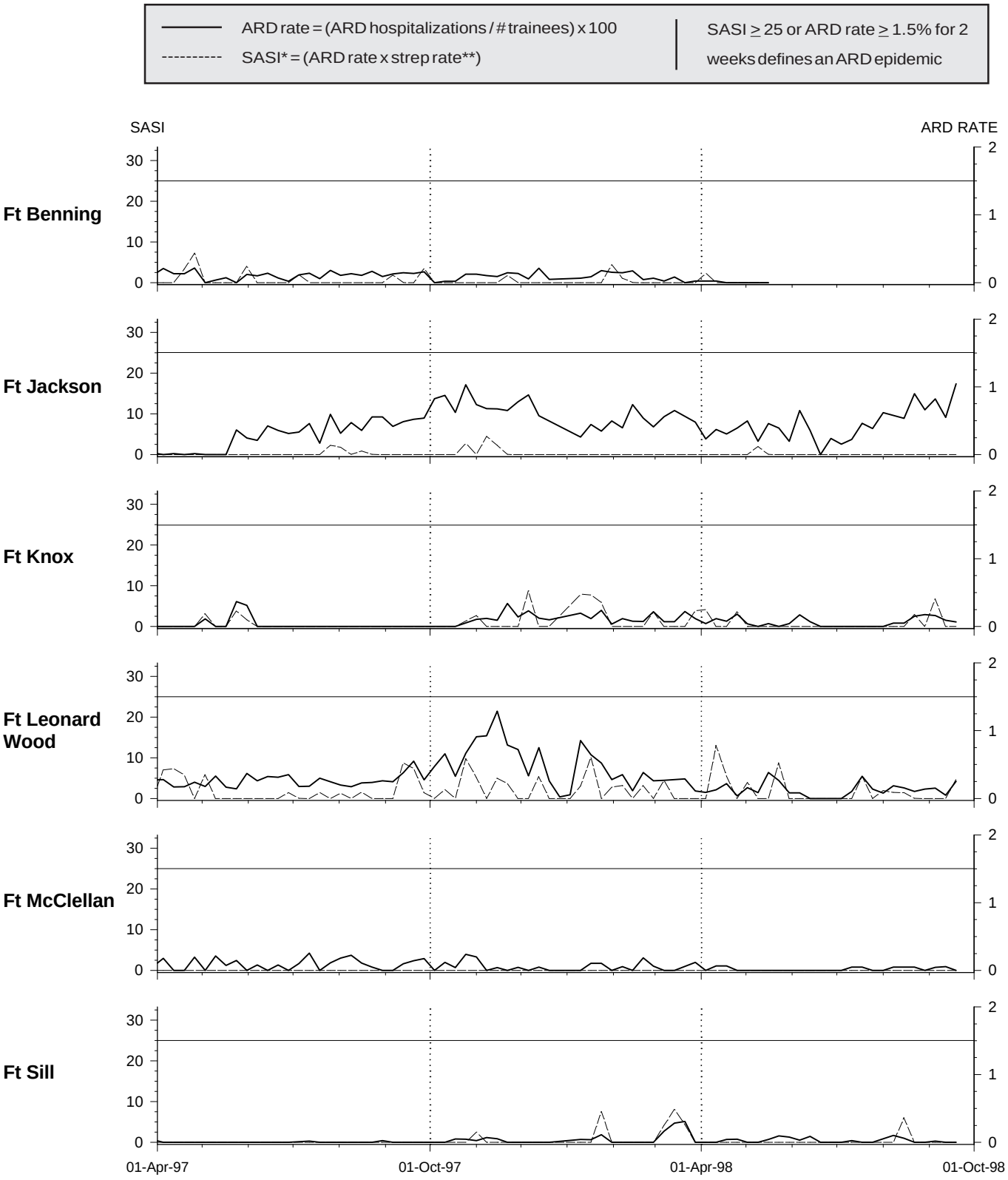
Table 2. Multivariate analysis, BAMC RGM outbreak investigation, June 1998, BMTU cases (n=14) versus BMTU/Hematology-oncology ward controls (n=46)

Variable	*AOR	95% C	P value	**AOR	95%CI	P value
Central venous catheter inflammation	7.63	1.32 – 44.08	**0.02**	34.79	0.67 - 1808.91	0.07
Positive blood culture	6.38	1.06 – 38.39	**0.04**	33.79	0.41 - 2767.18	0.11
Brand "A" catheter	4.85	0.44 – 53.11	0.20	33.72	0.79 - 1431.68	0.06
Race (caucasian)	4.06	0.62 – 26.74	0.15	0.28	0.003 - 29.08	0.59
Gender (female)	2.95	0.47 – 18.66	0.25	0.11	0.002 - 6.48	0.29
Mucositis during hospitalization	1.62	0.35 – 7.42	0.54	0.33	0.002 - 41.00	0.65
Age (per year)	1.05	0.98 – 1.13	0.13	1.10	0.94 - 1.29	0.23
Neutropenia (per day)	0.93	0.82 – 1.06	0.27	0.80	0.47 - 1.34	0.39

NOTE: *AOR = Adjusted odds ratio, adjusting for age, gender, and race

**AOR = Adjusted odds ratio, adjusting for age, gender, race, and other variables

Figure III. Acute respiratory disease (ARD) surveillance update
US Army initial entry training centers



* SASI (Strep ARD Surveillance Index) is a reliable predictor of serious strep-related morbidity

** Strep rate = (Group A beta-hemolytic strep(+) / # cultures) x 100

Continued from page 12

Summary of findings: The epidemiologic investigation documented a significantly increased rate of rapidly-growing mycobacterial infections at Brooke Army Medical Center between April 1997 and May 1998. The increased risk affected almost exclusively BAMC bone marrow transplant recipients. During the high risk period, the BAMC potable water system was contaminated with rapidly-growing mycobacteria – and as time progressed, the level of contamination seemed to increase. During this period, rates of other nosocomial infections, such as *S. aureus* and *S. epidermidis*, were comparable on the bone marrow transplant and hematology-oncology wards. There was no evidence of a significant breakdown in infection control practices on the bone marrow transplant unit.

Recommendations: Based on its findings, the team made the following recommendations: The hospital infection control committee should establish a multi-disciplinary team to coordinate, track, and document effects of interventions. BAMC's laboratory should develop the capability to quantify mycobacteria in water samples and to support a comprehensive RGM surveillance program (if necessary, external laboratory support should be obtained). Bone marrow stem cell transfusion bags should be thawed in sterile (rather than tap) water baths prior to infusion, and ports of transfusion bags should not be immersed during thawing or warming procedures. Finally, the BMTU staff should continuously seek, evaluate, and implement more effective infection control measures (e.g., alcohol rather than tapwater for handwashing, especially prior to manipulations of central venous catheter or peripheral intravenous lines).

Since the exact level of control required to minimize infections from mycobacteria in potable water is unknown, a staged approach was recommended for the BAMC system. The specific goal of the first and most urgent stage of interventions was the decontamination (e.g., elimination of the biofilm) of the hot and cold water plumbing systems that served BAMC's most severely immunocompromised patients (i.e., BMT, hematology-oncology). Subsequent stages of interventions were aimed at reducing mycobacteria levels in the rest of the hospital.

Finally, the team recommended that rigorous surveillance for mycobacterial infections should continue, particularly among BMT and other severely immunosuppressed patients. As of mid-September, no additional RGM infections had been diagnosed among BAMC patients.

The investigation team included COL Jose L. Sanchez, MC, MAJ Roberto N. Nang, MC, Jerry A. Valcik, Jennifer Filippelli, John Brokaw, USACHPPM, and MAJ Robert M. Plemmons, MC, LTC Susan L. Fraser, MC, MAJ Dana Gruber, ANC, MAJ Bethany A. Alexander, ANC, COL David Dooley, MC, MAJ Rickey Myhand, MC, and LTC Kenneth Tannen, MSC, BAMC.

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Outbreak investigation

Foodborne Outbreak of *Salmonella* Gastroenteritis among US Army Soldiers, Dhahran, Saudi Arabia

Between 17 September and 3 October 1997, more than 110 US Army soldiers stationed at Eagle Town base camp, King Abdul Aziz Air Base, Dhahran, Kingdom of Saudi Arabia, reported to sick call with diarrhea. The diarrhea rate among Eagle Town tenants during the period greatly exceeded the background rate among US forces in Dhahran. *Salmonella* group C1 were isolated from one blood and eight stool specimens from symptomatic soldiers. On 4 October, the US Army physician in charge of the Eagle Town medical clinic requested assistance in evaluating and responding to the outbreak. On 5 October, a microbiologist (US Navy), a public health officer (US Air Force), and a public health journeyman (US Air Force) from the US Central Command/ Surgeon General (USCENTCOM/SG) Theater Medical Surveillance Team (TMST) stationed at Al Kharj, Kingdom of Saudi Arabia, traveled to Dhahran to assist in determining the magnitude and scope of the outbreak, its source, modes, and routes of transmission, and to recommend interventional and preventive actions.

For investigation purposes, a confirmed case was defined as isolation of *Salmonella* from a stool or blood sample of a soldier stationed in Dhahran during the outbreak period. A probable case was defined as a soldier stationed in Dhahran during the outbreak period with either (a) diarrhea of at least two days duration, and/or (b) two or more of the following symptoms (with at least one GI related): abdominal cramps, vomiting, nausea, headache, malaise, fever. Cases were detected by reviewing records at the Eagle Town medical clinic. Illnesses in 91 soldiers (approximately 14% of the Eagle Town base population) met the confirmed (n=49) or probable (n=42) case definitions.

Figure 1 shows dates of symptoms' onset among confirmed and probable cases. At least 12 new cases developed each day between 26 and 29

Figure 1. Epidemic curve (based on dates of onset of gastrointestinal symptoms) , Eagle Town base camp, Kingdom of Saudi Arabia, 13 September - 7 October 1997

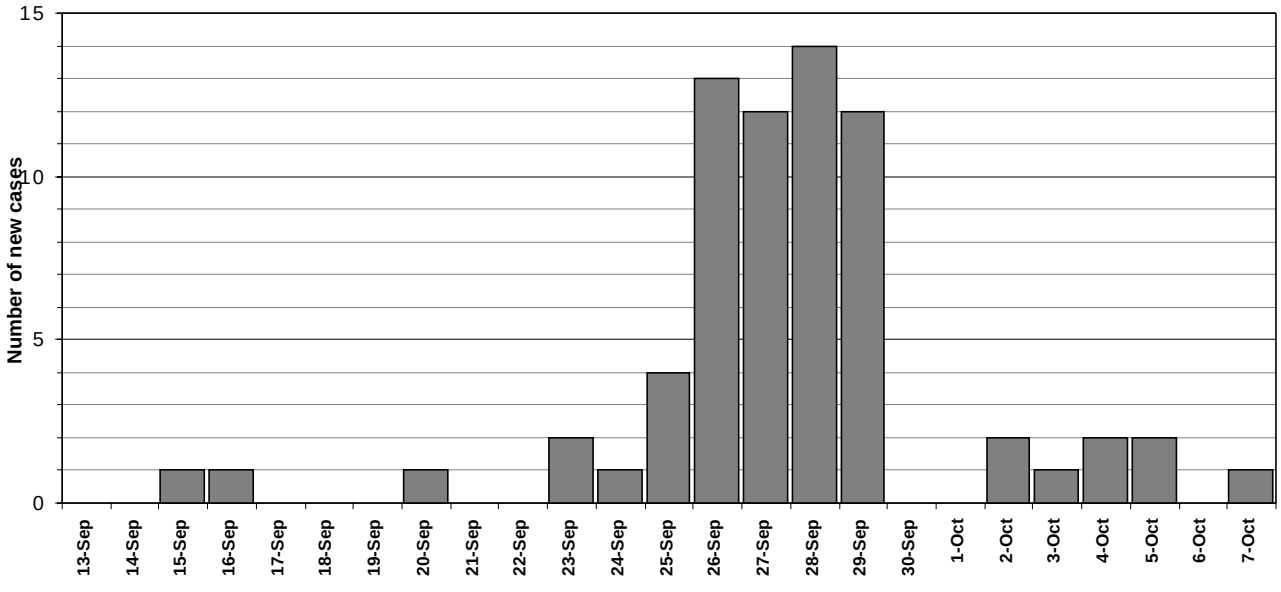
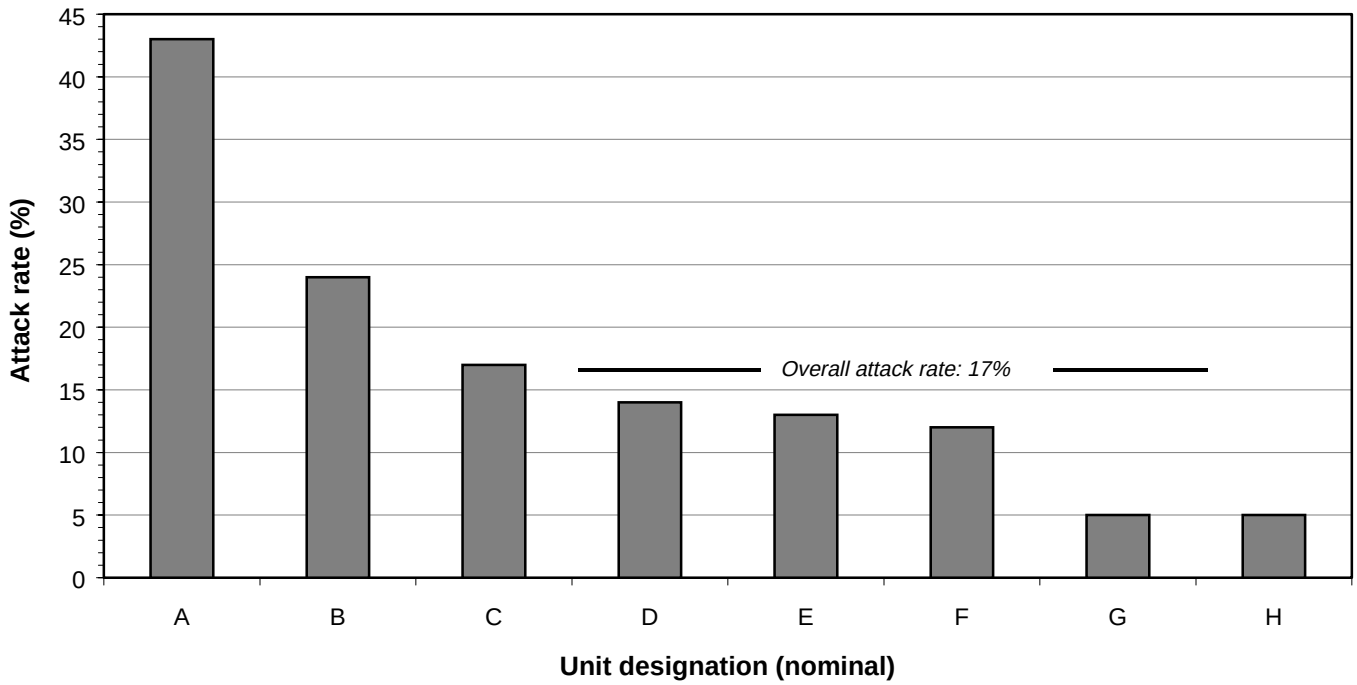


Figure 2. Cumulative incidence (%) of gastroenteritis during outbreak period, overall and among tenant units, Eagle Town base camp, Kingdom of Saudi Arabia



September – in contrast, only one other day during the period (25 September) had more than two new case presentations. Hence, the epidemic curve was more consistent with a point source of infection (e.g., single place and time) than a sustained chain of transmission (e.g., person-to-person). Cases (overall) of gastroenteritis were assigned to eight Eagle Town tenant units (figure 2); however, one infantry company ("unit A") had by far the highest attack rate (cumulative incidence: 43%) and accounted for more than half of all confirmed cases.

Symptoms of cases included diarrhea (94%; 54% of these had at least ten loose stools), abdominal cramps (85%), fever (56%), headache (52%), vomiting (43%), malaise (26%), and chills (25%). While symptoms persisted from one to 14 days, two-thirds of the illnesses (66%) lasted three days or less, and only one soldier was hospitalized (with positive blood cultures).

Using preliminary information (including menus from the most highly suspected meals), a questionnaire was developed to solicit detailed information regarding food and beverage consumption, sanitation, and personal hygiene practices. Eighty-six soldiers (49 cases, 37 noncases) from unit A completed the questionnaire and were interviewed regarding responses. While several food items were statistically associated with gastroenteritis (table 1), more cases recalled eating eggs (48 of 49, 98%) than any other implicated food item. Several breaches of proper sanitation and hygiene practices were identified; however, none were significantly associated, statistically, with gastroenteritis (table 2).

Finally, dining facility workers were cultured to identify potential *Salmonella* carriers. Of the 35 specimens collected, one was positive for *Salmonella* group C1. The positive specimen was from a supervisor who rarely handled utensils or prepared food or drinks. (Of interest, approximately two weeks prior to the outbreak, the supervisor experienced a brief episode of diarrhea which was followed three days later by "flu-like" symptoms). Subcultures of outbreak-related *Salmonella* iso-

Table 1. Food item questionnaire (86 respondents)

Item	# cases / # consumed item (attack rate: %)	# cases / # not consumed item (attack rate: %)	Attack rate ratio (consumed:not consumed)
Eggplant	11 / 11 (100)	38 / 75 (50.7)	1.97
Cabbage	11 / 12 (91.7)	38 / 74 (51.4)	1.79
Bread	7 / 7 (100)	42 / 79 (53.2)	1.88
Eggs	48 / 74 (64.9)	1 / 12 (8.3)	7.78
Cooked vegetables	32 / 44 (72.7)	17 / 42 (40.5)	1.80
French toast	27 / 37 (73.0)	22 / 49 (44.9)	1.63
Sausage	19 / 25 (76.0)	30 / 61 (49.2)	1.55
Shrimp	12 / 29 (41.4)	37 / 57 (64.9)	0.64

Table 2. Sanitation and hygiene responses

Activity	Relative odds of gastroenteritis (yes response vs no)	P value
Had place to wash hands	0.55	> 0.05
Soap at place where washing hands	0.78	> 0.05
Brushed teeth with potable water	1.00	> 0.05
Used ice from coolers	0.42	> 0.05
Drank cooler water from melted ice	1.89	> 0.05
Stored water packs in cooler	0.99	> 0.05

lates were sent to a reference laboratory in the United States to characterize their species and plasmid profiles.

In light of their findings, the epidemiology team made the following recommendations to local command and medical authorities: 1) the food service supervisor who tested positive for *Salmonella* group C1 should be prohibited from handling food items or utensils until two stool cultures collected on consecutive days at least 24 hours apart were negative (if treated with antibiotics, the first culture should be collected at least 48 hours after the last dose); 2) egg preparation practices should be thoroughly reviewed, with particular consideration of US Food and Drug Administration (FDA) guidelines (table 3, page 18); 3) food preparation utensils should be designated for single use to minimize chances of cross-contamination; and 4) efforts should be made to improve practices related to hand washing (e.g., facilities, supplies, compliance), water consumption (e.g., potable water storage, ice), and pest and refuse control (e.g., food storage, kitchen, and dining areas).

Editorial comment: In less than two weeks, nearly one of seven soldiers assigned to an Army base camp and more than 40% of soldiers in a single infantry company developed gastroenteritis, predominately due to salmonellosis. The outbreak and the epidemiologic investigation that followed provide several important insights. First, since the Department of Defense reorganized in the mid-1980s, major military operations have nearly always been joint rather than single service. This

investigation of a predominately US Army outbreak by a forward deployed multidisciplinary Air Force and Navy epidemiology team demonstrates the value of joint medical planning and training prior to, and sharing of professional manpower and technical resources during, joint operations. Second, routine outpatient morbidity surveillance in theaters of operations is required to enable timely detection of outbreaks, rapid characterization of their natures and scopes, and appropriate epidemiologic and disease control responses. Third, access of the troop medical clinic staff to in-theater clinical microbiology support (in this case, at the local Saudi hospital) was essential in identifying the etiologic agent, appropriately managing individual patients, and effectively responding to the outbreak. Finally, the importance and ubiquity of food- and water-borne pathogens worldwide, and the critical roles of food handling, water sanitation, and personal hygiene discipline, were reemphasized.

Information provided by Steven R. Hinten, MAJ, BSC, USAF, Richard L. Habergerger, CDR, MSC, USN, Karl J. Giese, SSgt, USAF, Dorina C. Maris, LT, MSC, USN, Robert J. Johnson, LTC, MC, FS, USAF, Theater Medical Surveillance Team, JTF-SWA, and David A. Twillie, MAJ, MC, USA.

Table 3. FDA Guidelines for Cooking Eggs

Preparation and/or usage	Recommendation
Eggs and foods containing eggs (general)	Cook until the yolk and white are firm. Cook throughout to 60°C (140°F) or above. Avoid eggs that are lightly cooked, e.g., soft-cooked.
Scrambled eggs	Cook at least 1 minute at 121°C (250°F). After cooking, the temperature of the eggs should be 73.9°C (165°F).
Poached eggs	Cook for 5 minutes in boiling water.
Fried eggs, sunnyside up	Cook in frying pan at 121°C (250°F): Uncovered: fry for at least 7 minutes. Covered: fry for at least 4 minutes.
Fried eggs, over easy	Cook with the frying pan at 121°C (250°F): Fry for at least 3 minutes on one side. Fry for at least 2 minutes on the other side.
Boiled eggs (in shell)	Completely submerge in boiling water for 7 minutes.
Single eggs	Crack single, rather than "pool" several, eggs.
Recipes with raw eggs **(e.g., home-made ice cream, Caesar dressing)**	Consider hazardous if not heated sufficiently.
Raw eggs	Don't eat raw eggs or foods that contain them.
Pasteurized, liquid eggs	Substitute for raw eggs when possible.

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